Claims:

1. A method of film deposition for integrated circuit fabrication, comprising:

chemisorbing at least one element from a first precursor on a wafer surface;

chemisorbing at least one element from a second precursor on the wafer surface; and

the at least one element from the first precursor and the at least one element from the second precursor chemisorbed to provide a tantalum-nitride film.

2. The method of claim 1, wherein the first precursor and the second precursor are delivered sequentially to form the tantalum-nitride film.

3. The method of claim 1, wherein the first precursor and the second precursor are co-reacted to form the tantalum-nitride film.

4. A method of film deposition for integrated circuit fabrication, comprising:

chemisorbing a first layer on a substrate, the first layer selected from a first tantalum layer and a first nitride layer;

chemisorbing a second layer on the first layer, the second layer different from the first layer, the second layer selected from a second nitride layer and a second tantalum layer;

the first layer and the second layer in combination providing a tantalum-nitride layer; and

plasma annealing the tantalum-nitride layer to remove nitrogen therefrom.

5. The method of claim 4, wherein the plasma annealing is performed with a plasma source material chemically non-reactive to the tantalum-nitride layer and having an atomic mass closer to nitrogen than tantalum.

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6. The method of claim 4, wherein the plasma annealing is performed with plasma source material selected from argon (Ar), xenon (Xe), helium (He), neon (Ne), hydrogen (H), nitrogen (N), and combinations thereof.

7. The method of claim 4, further comprising sequentially repeating the chemisorbing of the first layer and the second layer along with interspersed plasma anneals to provide the tantalum-nitride layer.

8. The method of claim 4, further comprising sequentially repeating the chemisorbing of the first layer and the second layer to provide the tantalum-nitride layer.

9. A method of film deposition for integrated circuit fabrication, comprising:

providing a process system, the process system having a chamber;

locating a substrate in the process chamber;

providing a first reactive gas to the chamber;

chemisorbing a first layer on the substrate at least in partial response to the first reactive gas, the first layer selected from a first tantalum layer and a first nitride layer;

conditioning the chamber with at least one of a purge gas or an evacuation;

providing a second reactive gas to the chamber; and

chemisorbing a second layer on the first layer at least in partial response to the second reactive gas, the second layer different from the first layer, the second layer selected from a second nitride layer and a second tantalum layer.

10. The method of claim 9, wherein the first reactive gas is a tantalum containing gas.

11. The method of claim 10, wherein the tantalum containing gas is a tantalum based organo-metallic precursor or a derivative thereof.

12. The method of claim 11, wherein the tantalum based organo-metallic precursor is selected from pentaethylmethylamino-tantalum (PEMAT), pentadiethylamino-tantalum (PDEAT), pentadimethylamino-tantalum (PDMAT), and derivatives thereof.

13. The method of claim 11, wherein the tantalum based organo-metallic precursor is selected from $Ta(NMe_2)_5$, $Ta(NEt_2)_5$, TBTDET, and tantalum halides.

14. The method of claim 10, wherein the second reactive gas is a nitrogen containing gas.

15. The method of claim 11, wherein the nitrogen containing gas is selected from an ammonia (NH_3) gas and a nitrogen plasma source gas.

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16. A method of film deposition for integrated circuit fabrication, comprising:

providing at least one process system, the at least one process system having a chamber;

locating a substrate in the chamber;

providing a tantalum containing gas to the chamber;

chemisorbing a first layer on the substrate at least in partial response to the tantalum containing gas;

purging the chamber with at least one purge gas;

providing a nitrogen containing gas to the chamber; and

chemisorbing a second layer on the first layer at least in partial response to the ammonia containing gas;

purging the chamber with the at least one purge gas; and

forming a plasma for annealing the second layer.

17. The method of claim 16, further comprising sequentially repeating the chemisorbing of the first layer, the purging of the chamber and the chemisorbing of the second layer to provide multiple tantalum-nitride sublayers.

18. The method of claim 16, wherein the substrate is maintained approximately below a thermal decomposition temperature of the tantalum containing gas for chemisorbing of the first layer.

19. The method of claim 18, wherein the substrate is maintained approximately above a thermal decomposition temperature of the tantalum containing gas for the chemisorbing of the first layer.

20. The method of claim 18, wherein the purge gas is selected from the group of helium (He), neon (Ne), argon (Ar), hydrogen (H_2), nitrogen (N_2), and combinations thereof.

21. The method of claim 20, further comprising providing a plasma source gas to the chamber for ignition to provide the plasma.

22. The method of claim 21, wherein the plasma source gas and the at least one purge gas is argon (Ar).

23. The method of claim 18, wherein the nitrogen containing gas is ammonia (NH_3).

24. A method of forming a barrier layer structure and an interconnect structure for use in integrated circuit fabrication, comprising:

providing a substrate having an oxide layer thereon, wherein the dielectric layer has recesses formed to expose portions of a surface of the substrate;

forming at least one tantalum-nitride layer on at least portions of the dielectric layer and the substrate surface, the at least one tantalum-nitride layer formed using a sequential chemisorption of tantalum containing and nitrogen containing precursor gases;

etching through portions of the at least one tantalum-nitride layer disposed within the recesses; and

depositing at least one metal at least in part in the recesses;

wherein the at least one tantalum-nitride layer mitigates to prevents migration of elements of the at least one metal to the dielectric layer.

25. The method of claim 24, wherein the metal is selected from aluminum (Al), copper (Cu), tungsten (W) or a combination thereof.

26. The method of claim 24, wherein the at least one metal is a refractory metal selected from titanium (Ti), tungsten (W), vanadium (V), niobium (Nb), tantalum (Ta), zirconium (Zr), hafnium (Hf), chromium (Cr), and molybdenum (Mo).

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27. The method of claim 24, wherein the sequential chemisorption process comprises forming alternating layers of tantalum and nitrogen.

28. The method of claim 27, wherein the alternating layers of tantalum and nitrogen are formed by sequentially pulsing a tantalum containing gas and a nitrogen containing gas with purging therebetween.

29. A software routine on a computer storage media, the software routine, when executed, capable of causing a general purpose computer to control a process system to perform a method of thin film deposition comprising:

forming a tantalum-nitride layer, the tantalum-nitride layer formed using a sequential chemisorption process, the chamber configured for the sequential chemisorption process to have a temperature of less than about 400 ^{0}C, the sequential chemisorption process comprising in part alternating pulses of a tantalum containing gas and a nitrogen containing gas.

30. The software routine of claim 29, further comprising:

controlling the process system to perform purges between formation of a tantalum layer and a nitride layer.

31. The software routine of claim 30, further comprising:

controlling the process system to provide a plasma after forming the tantalum layer and the nitride layer.

32. A method of film deposition for integrated circuit fabrication, comprising:

co-reacting a tantalum containing precursor and a nitrogen containing precursor to chemisorb a first layer on a wafer surface to provide a tantalum-nitride layer; and

plasma annealing the tantalum-nitride layer to remove nitrogen therefrom.

33. The method of claim 32, wherein the plasma annealing is performed with a plasma source material chemically non-reactive to the tantalum-nitride layer and having an atomic mass closer to nitrogen than tantalum.

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34. The method of claim 33, wherein the plasma annealing is performed with plasma source material selected from argon (Ar), xenon (Xe), helium (He), hydrogen (H), nitrogen (N), neon (Ne), and combinations thereof.

35. A method of film deposition for integrated circuit fabrication, comprising:
providing a chamber;
providing a plasma source gas containing nitrogen to the chamber;
igniting the plasma source gas to provide a plasma;
providing a tantalum containing gas to the chamber; and
co-reacting a the tantalum containing gas and the plasma to chemisorb on a wafer surface a tantalum-nitride layer.

36. A method of film deposition for integrated circuit fabrication, comprising:
providing a chamber;
providing a plasma source gas containing nitrogen to the chamber;
igniting the plasma source gas to provide a plasma;
chemisorbing a nitrogen layer on a substrate;
providing a precursor gas containing tantalum to the chamber; and
chemisorbing a tantalum layer on the substrate;
wherein the nitrogen layer and the tantalum layer in combination provide a tantalum-nitride layer.

37. A method of film deposition for integrated circuit fabrication, comprising:
providing a process system, the process system having a chamber;
locating a substrate in the process chamber;
providing a tantalum containing gas to the chamber;
providing a nitrogen containing gas to the chamber; and
chemisorbing tantalum and nitrogen from the tantalum containing gas and the nitrogen containing gas to provide a tantalum-nitride layer on the substrate.

38. The method of claim 37, further comprising plasma annealing the tantalum-nitride layer.

39. The method of claim 37, wherein the tantalum containing gas is a tantalum based organo-metallic precursor or a derivative thereof.

40. The method of claim 39, wherein the tantalum based organo-metallic precursor is selected from pentaethylmethylamino-tantalum (PEMAT), pentadiethylamino-tantalum (PDEAT), pentadimethylamino-tantalum (PDMAT), and derivatives thereof.

41. The method of claim 39 wherein the tantalum based organo-metallic precursor is selected from $Ta(NMe_2)_5$, $Ta(NEt_2)_5$, TBTDET, and tantalum halides.

42. The method of claim 39 wherein the nitrogen containing gas is ammonia (NH_3).

43. The method of claim 37, wherein the substrate is maintained approximately below a thermal decomposition temperature of the tantalum containing gas.

44. The method of claim 37, wherein the substrate is maintained approximately above a thermal decomposition temperature of the tantalum containing gas.

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45. A method of forming a barrier layer structure and an interconnect structure for use in integrated circuit fabrication, comprising:

providing a substrate having an oxide layer thereon, wherein the dielectric layer has recesses formed to expose portions of a surface of the substrate;

forming at least one tantalum-nitride layer on at least portions of the dielectric layer and the substrate surface, the at least one tantalum-nitride layer formed using co-reaction chemisorption of tantalum containing and nitrogen containing precursor gases;

etching through portions of the at least one tantalum-nitride layer disposed within the recesses; and

depositing at least one metal at least in part in the recesses;

wherein the at least one tantalum-nitride layer mitigates to prevents migration of elements of the at least one metal to the dielectric layer.

46. The method of claim 45, wherein the at least one metal is selected from aluminum (Al), copper (Cu), tungsten (W) or a combination thereof.

47. The method of claim 45, wherein the at least one metal is a refractory metal selected from titanium (Ti), tungsten (W), vanadium (V), niobium (Nb), tantalum (Ta), zirconium (Zr), hafnium (Hf), chromium (Cr), and molybdenum (Mo).

48. A software routine on a computer storage media, the software routine, when executed, capable of causing a general purpose computer to control a process system to perform a method of thin film deposition comprising:

forming a tantalum-nitride layer, the tantalum-nitride layer formed using co-reaction chemisorption of tantalum containing and nitrogen containing precursor gases at a temperature of less than about 300 ^{0}C.

49. The software routine of claim 48, further comprising:

providing an annealing plasma after forming the tantalum-nitride layer.

50. The software routine of claim 48, wherein the nitrogen containing precursor is a nitrogen plasma gas source.